APPENDIX C

PRELIMINARY SCREENING OF ALTERNATIVES

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Tables

Figure

This appendix provides additional information on the preliminary screening of alternatives within each disposal concept that is summarized in Section 4.2, Evaluation Process and Criteria.

C1 APPLICATION OF THE SCREENING CRITERIA

The criteria/factors were incorporated into a matrix and refined for use at a screening workshop on June 5, 2002. (The resulting matrices are included in Section C2 below with the resulting scores.) The two Disposal Work Groups assembled each alternative including information provided by the other groups (Drainage Quantity and Quality, Treatment, Cost Estimating, and Economics Work Groups) and scored the alternatives within a disposal concept. The Disposal Work Groups provided one or more recommendations on the preferred alternative(s) within each disposal option for the entire project team to consider at the workshop.

The criteria were applied in a tiered approach: first, the prevailing factors were cost (in 2002 dollars) and time to implement, and in the second round other factors (6 through 10) were thresholds for potential tie-breakers.

- **Costs.** The costs estimated for each complete alternative for this initial screening carry a level of uncertainty that needs to be accounted for. Selecting only the alternative with the lowest estimated cost may unreasonably limit future options. Therefore, the alternatives with the lowest estimated costs and those alternatives within 30 percent of the lowest cost were selected for further evaluation and screening in the second phase with the other factors.
- **Time to Implement.** This factor is critical given the court order to provide drainage service without delay. Independently of cost, the fastest alternative to implement will be maintained for further evaluation and screening in the second phase. The time to implement depends on two factors primarily: difficulty in acquiring permits and difficulty in acquiring land.

While cost and time are quantitative factors (natural scales of number of dollars and years), most of the other factors are subjective or nonquantitative and need a constructed evaluation scale. Each Disposal Work Group was required to make engineering and scientific judgments to complete the matrices, including use of evaluation scales (from 1 to 5) for scoring both the quantifiable and subjective criteria. To simplify the screening process, the nonquantitative factors were ranked with numbers 1 through 5. The most positive is 5, 3 is neutral, and 1 is the most negative.

For the subjective factors, Disposal Work Groups were asked to follow the example evaluation scales developed for Implementation criteria or modify these if appropriate. Each Disposal Work Group could change the explanations for rankings 1 through 5 to better fit its complete alternatives, but had to be consistent for all alternatives. The guidance/example evaluation scale for the Disposal Work Groups is presented in Table C-1 below.

Table C-1
Quantitative and Nonquantitative Screening Factors
Example Subjective Evaluation Scales

IMPLEMENTATION FACTOR

5 **Time to Implement (years)**

Estimated Time to Provide Services (from 1/1/03)

7 **Legal & Institutional Constraints**

Permitting Process

Scale

5 **No Permit Constraints** – No identified permit conflicts or permitting uncertainties; permit approvals can be granted by local or district authority

4 **Local Permit Constraints** – Challenging permit issues limited to local permit requirements

3 **Moderate Permit Constraints** – Challenging permit issues limited to one area of State or Federal permit process; permit approvals can be granted by local or district authority

2 **Substantial Permit Constraints** – Challenging permit issues include multiple local permits and one or more State or Federal permit requirements; permit approvals require special consideration by local or district authority

1 **Significant Permit Constraints** – State or Federal permit requirements in one or more areas require variances or special approvals from headquarters or governing bodies

8 **Flexibility to Meet Changing Conditions**

8A Potential future regulations

Scale

5 **Maximum Flexibility** – Alternative could meet all anticipated or suggested future regulations in all areas

4 **Substantial Flexibility** – Alternative includes flexibility to meet more stringent regulations in all areas identified for potential future regulation, but not necessarily all potential requirements

3 **Moderate Flexibility** – Alternative includes flexibility to meet more stringent regulations in a majority of areas identified for potential future regulation, but not necessarily all potential requirements

2 **Limited Flexibility** – Alternative includes flexibility to meet more stringent regulations in some areas identified for potential future regulation, but not necessarily all potential requirements

1 **No Flexibility** – Alternative could meet existing regulations with little margin or error for the areas identified for potential future regulation

8B Changes in drainage quantity or quality

Scale

5 **Maximum Flexibility** – Alternative could be scaled to perform effectively for all potential ranges of drainage quantity or quality, including drainage from areas outside the San Luis Unit.

4 **Substantial Flexibility** – Alternative could be scaled to perform effectively for all potential ranges of drainage quantity or quality for the San Luis Unit and the Grasslands area.

3 **Moderate Flexibility** – Alternative could be scaled to perform effectively for all potential ranges of drainage quantity or quality for the San Luis Unit only.

2 **Limited Flexibility** – Alternative would not demonstrate cost-effective performance if the drainage volume decreases or quality increases over time.

1 **No Flexibility** – Alternative is designed to perform effectively for a specified quantity or quality of drainage over time.

Weighting was done "de facto" with the number of factors chosen. The scores in each category were to be rolled up, averaged, and totaled. The alternatives selected in the first phase were to be evaluated and screened with the other factors (tie-breakers) in the second phase. Cost and time to implement were to be ranked based on their actual values. The scale 1 (worst) to 5 (best) was used, assigning 5 to the cheapest and fastest alternatives. The other factors' scales could be determined by the work groups. The specific details were not significant as long as the work group applied the scales consistently. When the factors and their scores were discussed at the June 5 workshop among the entire team, some changes to the scales were made to reflect the consensus of the team members.

C2 RESULTS OF ALTERNATIVES SCREENING AND OPTIMIZATION

The criteria/factors were incorporated into a matrix for use at a screening workshop on June 5, 2002. The results of the preliminary alternatives evaluation process are shown in the following tables (matrices).

- Screening of Ocean Disposal Alternatives, Table C-2
- Screening of Delta Disposal Alternatives, Table C-3
- Screening of In-Valley Disposal Alternatives with Drainwater Reduction, Table C-4

The tables below are subject to several caveats. For all of the alternatives, the cost-effectiveness, repayment ratios, and agricultural productivity factors were not applied because this information was not available by June 2002. Also, the scores reflect best professional judgement in most cases, especially where a subjective constructed score was applied. The scores must only be compared within a disposal alternative, i.e., within the ocean alternatives, not between in-valley or out-of-valley alternatives. The specific natural scores for cost and time to implement were preliminary, and updated information is contained in other sections of this Plan Formulation Report. In summary, the screening process relied on preliminary information that was available by June 2002 and on the professional judgement of the Project Team engineers, scientists, and planners.

Table C-2
Screening of Ocean Disposal Alternatives

	COST	Point Estero (300 cfs)	Needle Pt – Santa Cruz (300 cfs)	Needle Pt - Tunnel (300 cfs)	Needle Pt – Bay Floor Pipe (300 cfs)	Point Estero (100 cfs)	Needle Pt – Santa Cruz (100 cfs)	Needle Pt - Tunnel (100 cfs)	Needle Pt – Bay Floor Pipe
1	***Cost**		$149,313						
1A	* Annual Equivalent Costs ($1,000)	$136,565	$114,856	$135,364	$135,674	$123,281	$113,112	$144,702	$114,656
1B	* Construction Costs ($1,000)	$1,897,050	$1,596,200	$1,916,200	$1,916,200	$1,650,950	$1,544,300	$2,048,940	$1,578,940
	(1.3 times the least expensive)		$2,075,060						
2	**Cost Effectiveness**								
2A	Cost/Drained Acre in the San Luis Unit								
2B	Cost/Acre-foot of Drainage								
3	**Repayment Ratios**								
3A	Annual Cost per Acre-Foot								
3B	Annual Cost per Acre								
4	**Agricultural Productivity**								
4A	Change in Productive Acres (available in June)								
4B	Ag Production Value ($) (late Summer)								
	IMPLEMENTATION								
5	***Time to Implement (years)**	13	18	18	18				
	Estimated Time to Provide Service (from 1/1/05)**								
6	**Public Acceptability** *(PI Team to Assess)*	**4**	**1**	**1**	**1**				
6A	Political (Number of organizations/groups)								
6B	Public (# of issues/conflicts)								
7	**Legal & Institutional Constraints**	**2**	**1**	**1**	**1**				
	Permitting Process (Number of permits & complexity)								
8	**Flexibility to Meet Changing Conditions**	**3.5**	**2.5**	**3**	**2.5**				
8A	Potential future regulations	3	2	3	2				
8B	Changes in drainage quantity or quality	4	3	3	3				
	ENVIRONMENTAL IMPACTS								
9	**Land Impacts**	**4**	**3**	**4**	**4**				
9A	Operation Impacts	**4**	**4**	**4**	**4**				
9A1	*Rare/protected habitats and special status species*	4	4	4	4				
9A2	*Urban Corridor*	4	4	4	4				
9B	Construction Impacts	**4**	**2**	**4**	**4**				
9B1	*Rare/protected habitats and special status species*	3	3	3	3				
9B2	*Urban Corridor*	5	1	5	5				
10	**Risk**	**4.25**	**3.5**	**3.75**	**3.5**				
10A	Social	**4**	**3**	**3.5**	**3**				
10A1	*Change in drinking water quality*	5	5	5	5				
10A2	*Hazards (Earthquake, flood, etc.)*	3	1	2	1				
10B	Environmental	**4.5**	**4**	**4**	**4**				
10B1	*Locally Available Dilution*	5	4	4	4				
10B2	*Potential for wildlife exposure to selenium*	4	4	4	4				
	Total	**17.75**	**11**	**12.75**	**12**				

* **Most important factors**

** Includes permitting, design, and construction; does not include legal challenges

Factors 6, 7, 8, 9, and 10 (Public Acceptability, Legal & Institutional Constraints, Flexibility to Meet Changing Conditions, Land Impacts, and Risk) are subjective, nonquantifiable criteria. Disposal Work Groups will follow the example evaluation scales developed by the Evaluation Process and Criteria Work Group for ranking each complete alternative. Each Disposal Work Group may change the explanations for rankings 1 through 5 to better fit their complete alternatives, but must be consistent for all alternatives.

Table C-3
Screening of Delta Disposal Alternatives

	COST	Chipps Island (300 cfs all pipe)	Carquinez Strait (300 cfs all pipe)	Chipps Island (300 cfs canal and pipe)	Carquinez Strait (300 cfs canal and pipe)	Chipps Island (100 cfs all pipe)	Carquinez Strait (100 cfs all pipe)	Chipps Island (100 cfs canal and pipe)	Carquinez Strait (100 cfs canal and pipe)
1	***Cost**			$109,086					
1A	* Annual Equivalent Costs ($1,000)	$115,417	$160,181	$83,912	$127,396	$117,966	$135,432	$99,610	$135,432
1B	* Construction Costs ($1,000)	$1,583,500	$2,253,500	$1,153,500	$1,803,500	$1,631,700	$1,891,700	$1,371,700	$1,641,700
	(1.3 times the least expensive)			$1,499,550					
2	**Cost Effectiveness**								
2A	Cost/Drained Acre in the San Luis Unit								
2B	Cost/Acre-foot of Drainage								
3	**Repayment Ratios**								
3A	Annual Cost per Acre-Foot								
3B	Annual Cost per Acre								
4	**Agricultural Productivity**								
4A	Change in Productive Acres (available in June)								
4B	Ag Production Value ($) (late Summer)								
	IMPLEMENTATION								
5	***Time to Implement (years)**	28	28	28	28	28	28	28	28
	Estimated Time to Provide Service (from 1/1/05)**								
6	**Public Acceptability** *(PI Team to Assess)*	**1**	**2.5**						
6A	Political (Number of organizations/groups)								
6B	Public (# of issues/conflicts)								
7	**Legal & Institutional Constraints**	**1**	**1**						
	Permitting Process (Number of permits & complexity)								
8	**Flexibility to Meet Changing Conditions**	**1.5**	**1.5**						
8A	Potential future regulations	1	1						
8B	Changes in drainage quantity or quality	2	2						
	ENVIRONMENTAL IMPACTS								
9	**Land Impacts**	**2.25**	**2.25**						
9A	Operation Impacts	**2.5**	**3**						
9A1	*Rare/protected habitats and special status species*	1	2						
9A2	*Urban Corridor*	4	4						
9B	Construction Impacts	**2**	**1.5**						
9B1	*Rare/protected habitats and special status species*	2	2						
9B2	*Urban Corridor*	2	1						
10	**Risk**	**1.25**	**2**						
10A	Social	**1**	**2**						
10A1	*Change in drinking water quality*	1	3						
10A2	*Hazards (Earthquake, flood, etc.)*	1	1						
10B	Environmental	**1.5**	**2**						
10B1	*Locally Available Dilution*	2	3						
10B2	*Potential for wildlife exposure to selenium*	1	1						
	Total	**7**	**9.25**						

***Most important factors**

**Includes permitting, design, and construction; does not include legal challenges

Factors 6, 7, 8, 9, and 10 (Public Acceptability, Legal & Institutional Constraints, Flexibility to Meet Changing Conditions, Land Impacts, and Risk) are subjective, nonquantifiable criteria. Disposal Work Groups will follow the example evaluation scales developed by the Evaluation Process and Criteria Work Group for ranking each complete alternative. Each Disposal Work Group may change the explanations for rankings 1 through 5 to better fit their complete alternatives, but must be consistent for all alternatives.

Table C-4
Screening of In-Valley Disposal Alternatives with Drainwater Reduction

	COST	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
1	***Cost**			$123,691			
1A	* Annual Equivalent Costs ($1,000)	$129,363	$125,454	$95,147	$97,535	$102,320	$105,380
1B	* Construction Costs ($1,000)	$1,727,700	$1,667,810	$1,261,960	$1,298,750	$1,304,530	$1,341,040
	(1.3 times the least expensive)			$1,640,548			
2	**Cost Effectiveness**						
2A	Cost/Drained Acre in the San Luis Unit						
2B	Cost/Acre-foot of Drainage						
3	**Repayment Ratios**						
3A	Annual Cost per Acre-Foot						
3B	Annual Cost per Acre						
4	**Agricultural Productivity**						
4A	Change in Productive Acres (available in June)	**1**	**2**	**4**	**3**	**3**	**3**
4B	Ag Production Value ($) (late Summer)						
	IMPLEMENTATION						
5	***Time to Implement (years)**	**12**	**8**	**2 to 8**	**2 to 8**	**2 to 8**	**2 to 8**
	Estimated Time to Provide Service (from 1/1/05)**						
6	**Public Acceptability** *(PI Team to Assess)*	**1**	**1.75**	**4**	**4**	**4.5**	**4.75**
6A	Political (Number of organizations/groups)						
6B	Public (# of issues/conflicts)						
7	**Legal & Institutional Constraints**	**2**	**3**	**3**	**3**	**3**	**3**
	Permitting Process (Number of permits & complexity)						
8	**Flexibility to Meet Changing Conditions**	**3**	**3**	**3**	**3**	**3.5**	**3.5**
8A	Potential future regulations	2	3	3	3	4	4
8B	Changes in drainage quantity or quality	4	3	3	3	3	3
	ENVIRONMENTAL IMPACTS						
9	**Land Impacts**	**3.5**	**3.5**	**3.5**	**3.5**	**4**	**4**
9A	Operation Impacts						
9A1	*Rare/protected habitats and special status species*	4	4	4	4	4	4
9A2	*Urban Corridor*						
9B	Construction Impacts						
9B1	*Rare/protected habitats and special status species*	3	3	3	3	4	4
9B2	*Urban Corridor*						
10	**Risk**	**1**	**2**	**4**	**3**	**4**	**4**
10A	Social						
10A1	*Change in drinking water quality*						
10A2	*Hazards (Earthquake, flood, etc.)*						
10B	Environmental						
10B1	*Locally Available Dilution*						
10B2	*Potential for wildlife exposure to selenium*	1	2	4	3	4	4
	Total	**11.5**	**15.25**	**21.5**	**19.5**	**22**	**22.25**

* **Most important factors**

** Includes permitting, design, and construction; does not include legal challenges

Factors 6, 7, 8, 9, and 10 (Public Acceptability, Legal & Institutional Constraints, Flexibility to Meet Changing Conditions, Land Impacts, and Risk) are subjective, nonquantifiable criteria. Disposal Work Groups will follow the example evaluation scales developed by the Evaluation Process and Criteria Work Group for ranking each complete alternative. Each Disposal Work Group may change the explanations for rankings 1 through 5 to better fit their complete alternatives, but must be consistent for all alternatives.

The public acceptability scores were revised based on discussion at the workshop which focused on key issues rather than on number of issues or organizations. The Public Involvement Work Group for the San Luis Drainage Feature Re-evaluation developed an approach to evaluate public acceptability of refined preliminary alternatives as part of the alternatives screening process.

In considering public acceptability, the Work Group focused on the broad public issues associated with an alternative. That is, does an alternative include elements or components that are stated concerns from members of the public. The team reviewed potential issues to identify the major public acceptability issues that could distinguish among alternatives within the same disposal concept. The team identified the following six public acceptability issues:

- **Source Water Quality** – Does an alternative have perceived impacts to fresh water supplies for agricultural or urban use, including groundwater and surface water (Delta)?
- **Marine Resources** – Does an alternative have perceived impacts on special or protected marine areas?
- **Surface Exposure to Selenium** – Does an alternative include substantial acres of open water resulting in perceived exposure of wildlife to selenium?
- **On-farm Operational Burden** – Does an alternative result in increased operational or regulatory burden on farm operations?
- **Responsible Use** – To what degree does an alternative include reuse or recycling of water or other constituents?
- **Production Acres Impact** – Does an alternative result in substantial acres of agricultural land converted for drainage facilities?

In developing this list, the Public Involvement Work Group identified issues about which one or more interests may have concerns. The issues are intended to provide a quick and relatively simple method for differentiating between alternatives within a disposal concept. The overall score is shown on Tables C-2 through C-4 rather than the scores for each individual issue.

The findings of this evaluation and screening process are summarized below by type of disposal alternative:

Ocean Disposal: The three options off Needle Point were discarded, and Point Estero was selected for the following reasons:

- Time to implement was less for Point Estero, 13 years rather than 18.
- Point Estero discharge location is outside the Monterey Bay National Marine Sanctuary.
- The more southerly location has the potential for other agencies to participate in conveyance and disposal facilities.
- Point Estero had the highest average score for “other factors” (17.75 versus 11-12.75).

Delta Disposal: The Chipps Island discharge location had the lowest cost, but “other factors” scored lower. The Carquinez Strait location was kept for further analysis, even though the cost was higher, because it avoids critical Suisun Marsh habitat, avoids municipal water inlets near Antioch, and is subject to greater tidal velocities and mixing.

In-Valley Disposal: Of the six alternatives (see Figure 4.2-2), Alternatives A and B were eliminated based on cost and land requirements. Alternatives C, D, E, and F were kept for optimization because they met the construction cost factor threshold, had the shortest time to implement (2 to 8 years), and had the highest scores for “other factors” (19.5 to 22.25).

The results of the screening process were subject to additional review and refinement. This refinement process included the following key components:

- Development of cost curves for drainage quantity versus cost
- Update of route and land costs
- Review of timelines for permits
- Optimization of drainwater reduction options
- Evaluation of treatment options
- Packaging disposal with drainwater reduction, treatment, and reuse components

Additional analyses were required to further reduce the number of In-Valley Disposal Alternatives. Figure C-1 shows the results of the additional analyses, specifically the alternatives and components of alternatives that were eliminated. The rationale for this refinement is provided below.

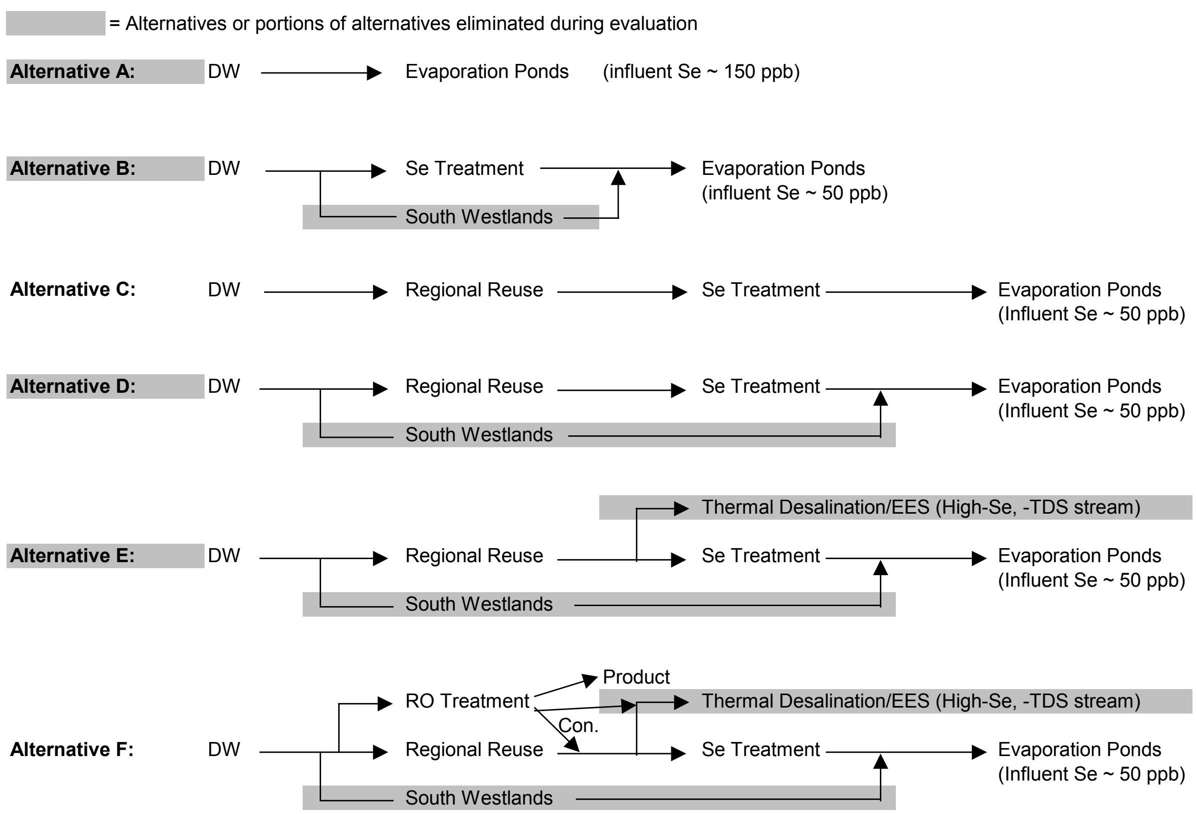

Figure C-1 Additional Evaluation of In-Valley Disposal Alternatives

The cost per unit of drainwater treated or disposed was calculated for each of the components in these alternatives. A comparison of the unit costs found that reuse is much less expensive than all other components per unit of drainwater disposed. It was concluded that all drainwater should be reused on salt-tolerant crops prior to other treatment and disposal options. Consequently, Alternative D was eliminated, and the South Westlands bypass option was removed from all alternatives.

The unit cost for the combination of thermal desalting/Enhanced Evaporation System was much higher than the unit cost for the combination of biotreatment/evaporation. Additionally, it was determined that biotreatment would be effective even in the high-total-dissolved-solids (>20,000 mg/L) environment that is projected to occur in the reused drainwater over the project life. Based on this information, Alternative E was eliminated, and the thermal desalting/Enhanced Evaporation System option was removed from all alternatives.

Thus far, the rating and analysis process eliminated Alternatives A, B, D, and E and portions of Alternative F as depicted on Figure C-1. The only remaining difference between Alternatives C and F is reverse osmosis (RO) treatment of a portion of the drainwater. The performance and cost of RO treatment are sensitive to the concentrations of hardness and total dissolved solids in the influent drainwater. The drainwater reduction analysis yielded projections of water quality for each of the four drainage zones over a 50-year period. The performance and cost of RO treatment was evaluated for each of the drainage zones and their projected water qualities over the project life. Various combinations of RO treatment, reuse, and biotreatment/evaporation were analyzed and compared to determine the optimum configuration of these components. This analysis produced the following conclusions:

- RO treatment should only be considered after drainwater reuse. Agricultural reuse of the drainwater is much less expensive than RO treatment for all potential combinations. Both options achieve similar rates of volume reduction and concentration of the drainwater although RO produces a high-quality product stream.
- RO treatment of reused drainwater from all Westlands subareas is not economical over the long term. Operation of RO at a recovery greater than 50 percent would require a very expensive softening pretreatment. Operation of RO at about 50 percent recovery would initially be economical because softening would not be required. The hardness of the reused drainwater, however, is projected to increase substantially within 10 years, and operation at 50 percent recovery would not be sustainable without softening pretreatment.
- RO treatment of reused drainwater from the Grassland Drainage Area would be economical over the long term. Projections of the drainwater quality indicate that RO operation at 50 percent recovery could be sustained during the project life without softening pretreatment.

The optimum configuration of the components in Alternatives C and F yields a hybrid that combines aspects of both. The drainwater flows from Westlands would follow the schematic of Alternative C. The Grassland Drainage Area drainwater would utilize the RO treatment of Alternative F after agricultural reuse. Concentrate from RO would undergo biological treatment to reduce the concentration of selenium followed by discharge to evaporation ponds.